International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

International Science Council
The global voice for science

Address: Schlossplatz 1, A-2361 Laxenburg, Austria
Telephone: +43 (0) 2236 807 000
Email: repository@iiasa.ac.at

2nd Consultation Report

Bouncing Forward Sustainably: Pathways to a post-COVID World

Strengthening Science Systems

Elena Rovenskaya, David Kaplan, and Sergey Sizov

1 September 2020

BAN KI-MOON CENTRE for Global Citizens
futurearth Research. Innovation. Sustainability.
The Earth League
VIENNA ENERGY FORUM

Table of contents

Introduction 3
About the authors 4
Acknowledgments 4
The Process 5
The Discussion 6
Break-away group 1: Access and partnership 6
Break-away group 2: Agility and quality 9
Break-away group 3: Public, policy and science 12
Annex 1 – List of Participants in the 2nd Consultation 15
Annex 2 – Orientation and Extended Agenda 17
Annex 3 – Results of the Online Survey 20

Introduction

This report is in three parts. The first part of the report outlines the process of the 2nd Consultation. The second part of the report provides a summary of the discussion which is grouped around the *draft recommendations* put forward in the Second Background Paper (link) produced for the 2nd Consultation. The discussions at the 2nd Consultation addressed only some aspects within each draft recommendation. In some cases, the discussion covered aspects which were not originally included in the Second Background Paper. This report presents only what was discussed at the 2nd Consultation. This report should be considered as complementary to the Background Paper (link), the 1st Consultation Report (link), and the Second Background Paper (link). Correspondence and off-line discussion with the participants, as well as work to analyze collected material continue. Hence this report should be treated as a work-in-progress.

About the authors

David Kaplan is Senior Research Specialist at the International Science Council (ISC) (Contact: david.kaplan@uct.ac.za).

Elena Rovenskaya is Program Director of Advanced Systems Analysis Program and Acting Program Director of Evolution and Ecology Program at the International Institute for Applied Systems Analysis (IIASA). She is also Research Scholar at the Faculty of Computational Mathematics and Cybernetics, Lomonosov Moscow State University, Russia (Contact: rovenska@iiasa.ac.at).

Sergey Sizov is Science Diplomacy Officer at the International Institute for Applied Systems Analysis (IIASA) (Contact: sizov@iiasa.ac.at).

Acknowledgments

The authors are thankful for the input provided by the participants of the 2nd Consultation: Kathie Bailey, Anne Bardsley, Carlos Henrique de Brito Cruz, Anne Cambon-Thomsen, Alexandra Freeman, Barbara Kalumenos, Ingrid Petersson, Dorsamy (Gansen) Pillay, Andrew Revkin, Magdalena Skipper, Mandi Smallhorne, Pradeep Srivastava, Maria Uhle, Murray de Villiers, Peter Weingart, and Xin Xu. We are especially thankful to Lidia Brito for excellent chairing of the 2nd Consultation and her contribution, as well as to Geoffrey Boulton, Eran Feitelson, and Helga Nowotny for chairing break-away groups that enabled rich and constructive discussions. We also thank Nikita Strelkovskii for his assistance with the survey and the production of the systems map.

The Process

The 2nd Consultation was a 3-hour webinar that took place on 20 July 2020. The meeting brought together nineteen renowned representatives of the science funders, the private sector, science journalists, publishers and those concerned with public understanding of science, as well as members of the IIASA-ISC Team (Annex 1). **The aim of the 2nd Consultation was to reflect and critically review the draft recommendations that emerged from the discussion in the 1st Consultation and from the review of literature conducted by the IIASA-ISC Strengthening Science Systems Team.**

The Second Background Paper (link) presented draft recommendations to be discussed in the 2nd Consultation. In total ten draft recommendations were clustered in three buckets. The first bucket, Access and partnership, focused on issues of open science, peer review system, and partnership with the private sector, which are critical means to achieve *increased agility* and *enhanced reliability* of science in its service to society. *Increased agility* and *enhanced reliability* of science will also be facilitated through the recommendations clustered in the second bucket, Agility and quality. This covers research priorities, funding, and scientific cooperation as key enablers of scientific progress. Finally, the third bucket, Public, policy and science, focused on the public understanding of science, trust in science, and the science-to-policy advisory system, which ultimately help advancing towards *a more effective science-policy-society interface.* The systemic interlinkages across these ten recommendations are depicted in a causal map (Fig. 1).

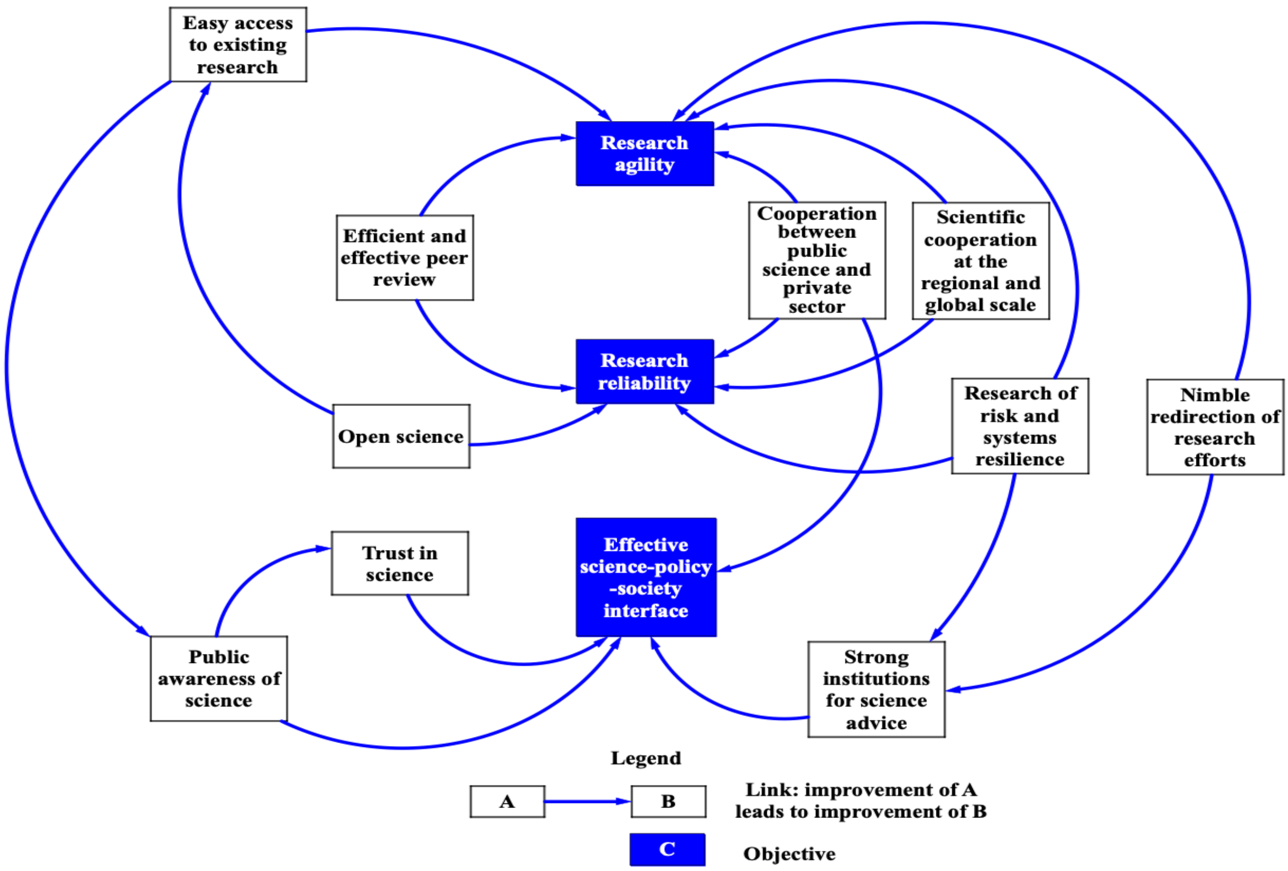

Figure 1: Causal interlinkages among ten draft recommendations and their effect on the three axes of improvement.

Prior to the meeting, the participants received the Second Background Paper: Input to the 2nd Consultation; the Report on the 1st Consultation; the list of participants, a listing of the Break-away Groups; and an Orientation and Extended Agenda which outlined the issues for discussion and the expected outcomes (Annex 2).

The 2nd Consultation was organized in three break-away groups. Each group addressed one bucket of recommendations. Participants were assigned to break-away groups based on their expertise. Defined times were allocated for discussions of each recommendation. Each break-away group was chaired by a scientist who participated in the 1st Consultation. The participants shared a number of relevant experiences from the COVID-19 situation, deliberated on how the draft proposals could be further elaborated and on the mechanisms that could help to implement the recommendations.

In the plenary session that followed the break-away groups, short summaries of the deliberations in each group were presented by rapporteurs. Participants were then invited to comment and provide input on all of the recommendations.

Towards the end of the meeting, participants were asked to complete an online survey. The survey asked respondents to address the question: *Which elements should be the most important focus for policy makers to strengthen the capability of the science system and its capacity?* The results of the survey are presented in Annex 3.

The engagement with the participants in the 2nd Consultation continues after the meeting. Participants have been asked to provide additional written comments. The IIASA-ISC Strengthening Science Systems Team will synthesize all inputs, also from the earlier documents produced in this process, and will prepare a revised list of draft recommendations (Draft Recommendations 2.0) with appropriate substantiation. These recommendations will serve as input to the 3rd Consultation.

The 3rd Consultation will include representatives of the policy making community, as well as the private sector. Participants in the 3rd Consultation will be asked to further reflect on the feasibility and implementation of the proposed recommendations. After the 3rd Consultation, the final report with the resultant recommendations and their substantiation will be produced.

The Discussion

To reiterate, with reference to the COVID-19 crisis, the discussion was structured around the three buckets of recommendations put forward in the Second Background Paper and their effect for *increased agility* and *enhanced reliability* of the science systems, as well as for *a more effective science-policy-society interface*. This section of the report is by no means a comprehensive record of the discussion but rather a summary of some of the main issues discussed.

Break-away group 1: Access and partnership

Efficient and effective peer review of publications: The peer-review system should be seriously re-examined with regard to rigidity and slowness of paper processing.

- *A system of review for preprints should be established*. Over the last few decades, we have seen the development of a process that enables speedier access to research results by online deposition of preprints. The COVID-19 crisis saw a rapid proliferation in preprints. Preprints are particularly valuable at times of urgent crisis, by speedily placing relevant research in the hands of those addressing the crisis and those of concerned citizens. However, preprints immediately relevant to crisis management have the potential to impede or derail management if they are flawed or misconceived, creating an urgent need for systems of rapid preprint review. At present, there is no formal agreement as to how to manage the review process for preprints.

- *There should be a post-publication review of preprints so as to allow readers to have an overall assessment of the quality.* One possibility is, not to provide a comprehensive review and not to use the review to accept or reject a preprint, but rather to provide elements of a review so that readers can take some view on the merit. This would simplify the review process and allow for a rapid review process.

- *Scientific journals should rapidly mobilise the review system in a crisis. The review system should be international, rigorous and inclusive.* The challenge to the international science community is to create a response that is rigorous, inclusive, responsive to diversity and of global scale. In a global emergency, processes of dissemination and review also need to be global, and responsive to diverse national capacities and needs. An international system with a data base of potential reviewers that can be rapidly mobilised needs to be put in place. Artificial Intelligence (AI) can be a useful mechanism to identify appropriate reviewers. International organisations of science, such as the International Science Council (ISC) and UNESCO, should be engaged to suggest how such an action-ready system could best be organised through urgent dialogue with international disciplinary bodies, national academies and national research councils.

- *The peer-review system must be made more agile.* The swift publication and dissemination of rigorous research is a pre-requisite for both rapid progress in science and effective science advice to policy and society, particularly in crisis situations such as that of COVID-19. The peer review system is designed to ensure, as far as possible, the maintenance of high standards of rigor. The long-standing system is one of peer review prior to formal publication, but this is a relatively slow process.

- *The incentives for peer review should be increased.* Currently, there is little incentive for scientists to undertake peer review. As a result, journals have difficulty in locating willing reviewers and ensuring a swift review process. There is a clear need to develop incentives to encourage and reward reviewers. It is becoming increasingly clear that incentives for the unpaid work of reviewing, currently done on a large scale by academics, will be necessary if high standards of review are to be sustained and strengthened. Apart from material incentives, much more acknowledgement and recognition for reviewers is required by journals and in the career assessment of scientists. One possibility is to adopt open authorship of reviews and to recognize them as a form of publication. This would serve to incentivize quality reviews.

- *Scientists should be trained to be effective reviewers.* The development of the capacity for effective review should become a constituent part of the training of scientists. A change of mind-set is required whereby effective review is seen as a vital part of the scientific enterprise. The idea of developing specialist reviewers does not receive strong support. The use of AI as the sole method of review was also not supported, but the potential role of AI in supporting the organisation and operation of reviewing systems needs urgently to be explored.

- *There is a need for strong peer review systems for data.* Better and more agile peer review systems are necessary not only for scientific articles but also for data. The COVID-19 experience not only underlines the necessity of strong peer review systems for scientific articles but also for the data on which many scientific truth claims depend. Effective peer review is predicated on access to the date, but also to the models and computer codes that provide evidence for scientific claims.

Open science: The move to open science – open access publishing; open methods, models, data; open to society – is a priority for science. Open science is critical to ensuring science is global and cooperative.

- *Open access to the record of science should be accelerated*. An open science movement has been growing rapidly based on the opportunities created by the digital revolution and ongoing changes in the habits of scientific inquiry. However, open access to the record of science is far from being achieved. Many original research findings are still presented in formally published peer-reviewed journals where access is deterred by high paywalls. In the context of COVID-19, major commercial publishers recently allowed access to scientists searching for anti-viral treatments. Such a stance should be encouraged so as to become widespread and permanent.

- *Data, models, and computer codes that provide evidence for scientific claims must be concurrently accessible for scrutiny and reproducibility*. The sharing of data is fundamental to ensuring the integrity of the research. Data availability is required for reproducibility and the enhancement of Open Science. Data, models, and computer codes that provide evidence for scientific claims must be concurrently accessible for scrutiny and reproducibility. The FAIR approach to these issues (Findable-Accessible-Interoperable-Reusable) provides a necessary framework. Data should be deposited in open well-managed repositories, whilst it should be the responsibility of funders as a condition of funding, and of journals as a condition of publication that related data are concurrently and openly available. Computer code utilised in manipulating data or in models should also be openly available, whilst in some cases, characteristics of the machine that undertook the computation will also be required. Open source software should be used in these operations as much as possible. Most activities within the research process are now digitally connectable, and could in principle be made openly accessible, thus liberating much value that has hitherto rarely been exposed.
- *The incentive system for sharing information by scientists should be fundamentally changed.* At present, science incentives are almost entirely focused at the publishing end – the final paper. This has a number of drawbacks, including importantly locking up all knowledge until final publication in a learned journal. Deposition of data in a publicly accessible depository prior to publication would allow access on the part of other researchers and significantly speed up the scientific process. Scientists should be rewarded for the deposition of data. As much as they are prepared to pay for research, funders should also be prepared to pay for data deposition. Apart from data and code, other well-grounded products of the research process such as substantive ideas/ hypotheses, research protocols, interpretations etc. should be shared with the community and be eligible for funding. Suitable formats for sharing of these other products should be identified. Attributing authorship for the different components of the research process through this system would allow for greater levels of accountability. The key is to develop a system that allows for the widest and most rapid diffusion of knowledge while simultaneously rewarding new scientific discovery.
- *Science communication must be improved*. Science must be better communicated by scientists. Open science requires that science be accessible to the public and communicated to the public. In general, there is no appetite on the part of scientists to recognize the science-public interface as being as important as the science itself. Scientists see themselves as researchers producing science; not communicating science. We need a complete mindset change here among scientists and amongst funders. Scientists should be trained and incentivized in the communication of science.
- *The engagement of citizens in science must be enhanced.* Currently scientists have little if any incentive to engage the general public with the research in any way. But, engagement with society is a vital attribute of open science. Scientifically-informed policies need public acquiescence if they are to be implemented. More fundamentally citizen engagement in science is a democratic imperative in a world increasingly conditioned by science. Citizen science is an important contribution to a more socially engaged science that must be complemented by deeper general engagement at the science-society interface in the co-construction of actionable knowledge that responds to societal needs. There is again a need to create incentives for the scientific community to engage in processes of deliberative societal dialogue about the use of new knowledge and not merely in its creation. In addition to scientific merit, journals should regard engagement with society as a positive in determining publication.

Cooperation between public science and private sector: As many solutions rely on public-private research partnerships and on private sector technology platforms, mechanisms to enhance cooperation between public science and the private sector should be identified. Incentives for the public and private sector to share data and knowledge must be developed.

- *The private sector is critical in responding to emergencies.* The critical importance of the private sector in the response to a global emergency has been highlighted by the COVID-19 pandemic. In many areas, businesses are engaged in partnerships with the public sector. This is particularly evident in vaccines – there are more than three dozen COVID-19 vaccines currently under development, of which several are in partnership with scientists in the public sector. In terms of technology platforms, track and trace systems and digital health technologies used by the governments rely on ICT systems developed by business.
- *Collaborative efficiency across the public private interface must be enhanced.* The collaborative efficiency across the public - private sector interface varies with discipline. Collaboration and mutuality across the interface are strong in those academic disciplines that lead directly on to private sector professional activity, such as medicine, engineering, geology, chemistry and computer science/AI etc. But service industries for example, dominant in some advanced economies, although they depend upon data and AI algorithms often supplied by others, have few natural links with the science community. In all cases however, "relational professionals" that are able to communicate sensitively to both communities are of great value. Funding bodies have a major role to play here, in creating funding programmes that address practical problems and need collaborative engagement between scientists and industry, policymakers, and citizens.
- *The proclamation of a global crisis should be a signal for more extensive cooperation between science in the private and public spheres.* The emergence of a major global crisis such as Covid-19 should in principle bring public and private sectors together in addressing pressing global challenges whilst temporarily setting aside sectional interests. The proclamation of global crisis, perhaps by the United Nations, could signal the need for a common effort across the public-private interface, with attendant financial protocols to spread risks, avoid jeopardy and ensure appropriate financial returns.

Break-away group 2: Agility and quality

Research on risk and systems resilience: Critical risks and the resilience of socioeconomic-environmental systems should be a key focus of future research. Attention should be given to the decision-making contexts, policy implementation, and societal responses.

- *Scientists should interrogate the potential impact of their research on recognized societal challenges and how the research findings could contribute to addressing these challenges*. Researchers should not forget that if their work is financed through public funding, they work in the interest of the society and all their work belongs to the public.
- *Multiple risks should be researched.* Some risks, for example nuclear safety, are traditionally studied rather extensively, while other risks receive less attention. In today's highly interconnected world, risks of very different nature can trigger globally disastrous consequences, Hence, in order to be able to base vital decisions on scientific evidence, countries – especially in the developing world – should develop their science and technology capacities across a broad range of risk areas.
- *International scientific cooperation should be further developed.* Scientist-to-scientist connections across borders between developing and developed countries are very helpful in producing science advice swiftly. Ultimately, science is a global good and nations can benefit greatly from sharing knowledge and insights more, especially at times when science evidence is needed urgently to inform policy decisions.

- *The multi-dimensionality of risks should be recognised*. Another limitation of the current approach in risk research is that often a risk is studied within the discipline(s), where the origin of the risk and its primary effects are located. Secondary and further indirect effects receive less attention. However, they may actually be very significant. For example, up to now, publications related to COVID-19 are predominately focused on health aspects even though the new coronavirus integrates many dimensions from health to employment to financial impacts to governance issues and beyond. Future crises are similarly likely to be multi-dimensional. Research that takes an integrated view on possible future risks is therefore necessary. Complex systems can be a suitable framework for such research.
- *A strong input from the social sciences, notably, the history of earlier crises and the research of governance systems, is needed*. A stronger involvement of social science in risk research aimed at better understanding of the soft systems – social systems and institutions – is needed to inform quantitative models and local decisions. Future research should pay more attention to specific societal weaknesses and political, social, economic context the decision-making realities of countries. A straightforward transfer of insights and practices, for example, from the Global North to the Global South can have very different and unanticipated outcomes. (An important example - the development of private-public partnerships in countries where the rule of law is weak will have very different results from that in countries where the rule of law is strong). As humanity deals with exogenous crises periodically throughout its existence, useful lessons can be derived from the past, and hence the history of crises and attendant societal responses should be integrated into research on risk.
- *Important tradeoffs should be in the focus of future research*. There are two major tradeoffs that are pertinent to many risks. One tradeoff is that between a system's efficiency and flexibility which is often achieved by a greater redundancy of functions or processes in the system. For example, the striving for cost efficiency has led to the emergence of cross-continental supply chains involving a large number of intermediate suppliers. This has created a situation when the successful delivery of the final good to the consumer market requires that all elements of the long value chain function as expected. The COVID-19 crisis highlighted the fragility of such cost-effective systems under the conditions of a lockdown and the negative impact on the security of supply. Thus, tradeoffs between efficiency and flexibility should be better understood across different risk areas. Future research should focus on deriving smart solutions that improve both dimensions.

  Another important tradeoff is related to the time dimension. Making decisions under risk and uncertainty, a decision maker trades off the present benefits and losses versus the future anticipated losses. In economics, this tradeoff is resolved by the introduction of a social discounting of future. However, social discounting, is strongly criticized within the discipline. Moreover, any extension of this concept to non-economic matters seems to be even more problematic. More research is required to better understand the notion of inter-generational justice in this context and to develop decision support tools which would inform just decisions.
- *A compelling research agenda on risk research should be provided to funders.* Funding research on multi-faceted risks is a challenge as governments continue to adopt a silo approach to risk management. There is a need for a new research agenda on risk and resilience in the context of systems perspective and complex systems. This new agenda should be formulated through a broad participation of the science community (for example, in the format of a discussion paper). This proposed new agenda on risk research should then be taken to the government and funders for support.

Nimble re-direction of research efforts: Mechanisms must be put in place to allow researchers to move rapidly into new areas of public policy concern. This entails funding, performance evaluations for career development and leadership.

- *Institutions are required to facilitate a rapid re-direction of research efforts.* COVID-19 triggered considerable spontaneous research efforts by individual scientists and groups in various disciplines.

While this has had largely positive outcomes, the re-direction of research efforts was not anticipated prior the crisis. Institutions should be put in place to ensure that research efforts can be re-directed as needed in future crisis situations. One possible institutional mechanism could be to create "emergency teams" possessing relevant and complementary expertise needed to deal with particular kinds of exogenous shocks. These "emergency teams" could exist in a stand-by mode being ready to be activated on demand. Funding for the active work of such emergency teams could then be arranged without incurring the delays necessarily entailed in securing funding through a competitive process.

- *There should be a certain level of flexibility in public funding allocation.* National funding agencies typically receive money from the government to support research according to national priorities. The funding agencies have limited freedom to re-direct funding for different subjects in a short period of time; in practice any re-direction of funding often happens through adjustments within the existing calls. However, such adjustments to existing calls can only release limited resources. A more significant re-direction would require an approval by the government, which can take time and requires political will. If the national funding agencies were to be given more flexibility in re-allocating of the public money, a high level of transparency and accountability for a change in priority would need to be requested. One possible mechanism could be to set aside some earmarked funding for research into issues emerging in crisis situations. However, one would need to carefully evaluate the tradeoff that such a solution would entail as it would mean that ongoing research will receive less funding.
- *Coordination among funders, scientists and policy makers should be enhanced.* As a first step, any deviation from the business-as-usual allocation of public finances requires making a judgement call that such a deviation is indeed justified. Who should be responsible for determining whether there is indeed such a justification? In the spirit of democracy, this could be determined through a dialogue and consensus-seeking decision-making among scientists, funders, and policy makers. Thus, more and faster communication channels between funding agencies, scientists and policy makers should be established now so as to be ready to be activated in times of the crisis for better coordination of efforts.
- *Good scientific practice in response to a rapidly developing crisis should be explicitly formulated and enforced*. About 40,000 COVID-related papers have been published to date. There is a widespread concern that the quality of some of these publications may be lower than the usual standards as these studies have been carried out too rapidly. This concern is only applicable to some of these publications. Many have managed to meet the quality standards despite time limitations. Good practices of how to conduct good quality research in response to a crisis should be analyzed and shared widely. Existing codes of scientific conduct should be amended with explicit statements detailing what constitutes cases of scientific misconduct that are likely to occur in times of an exogenous crisis. Institutions that enforce the scientific code of conduct (internal – at the universities and research organizations, and external – at the national or supra-national level) should be significantly strengthened.

Easy access to existing research: Mechanisms to facilitate utilizing already existing and emerging research results and insights to an exogenous crisis should be enhanced.

- *The use of accessible repositories for existing research and data by scientists should be promoted.* In some disciplines, for example, physics, such repositories were already routinely utilised before COVID-19. This has significantly facilitated scientific progress. Other disciplines, for example, medical science and biology, "discovered" this way of sharing research results during the COVID-19 situation. Some other disciplines are not yet there. A broad adoption of the practice of open access publishing across all disciplines should be promoted.
- *Easy access to the existing researchers for science translators should be arranged*. Open access publishing is also extremely useful for science translators and science journalists to get information. It has been argued that actually it is indeed the public (or the publics) who benefited the most from the open access publication system so far.

- *Beyond open access, platforms aggregating research on a particular topic should be developed*. There have been a number of platforms created to help navigate the totality of research on aspects of COVID-19. Their experience should be analyzed and recommendations as to how to facilitate and institutionalize such initiatives could be formulated on this basis.
- *Automatic language translation should be further advanced and used to make research in different languages accessible to everyone***.**
- *As the COVID-19 crisis has demonstrated, data sharing across national boundaries is vital for a rapid response of science.*

Scientific cooperation at the regional and global scale: Traditional mechanisms for building and maintaining global research networks are breaking down. Attention should be paid to the development of new mechanisms to encourage scientific cooperation at the regional and global scale, and particularly, to developing networks centered in the South.

- *The nationalization of science systems in many countries should be counter-acted*. In the recent times, a clear trend towards national rivalry and the "nationalization" of science systems in many countries has been observed. COVID-19 has clearly demonstrated the value of international cooperation. The demonstration of the value of international cooperation provided by COVID-19 should be used by scientists and others to further enhance the trend towards a higher degree of international cooperation and the understanding of science as a global good.
- *International joint research calls should be promoted*. In practice, many research funding mechanisms are national. An effective way to support and facilitate international collaboration is joint calls whereby each national funding body funds own researchers proportionally to their contribution to the project. Such funding mechanisms can establish the foundation for long-lasting collaboration between scientists well beyond the time of the call.
- *The connecting power of internet should be fully exploited to develop networks across the globe*.

Break-away group 3: Public, policy and science

Public awareness of science: The awareness of the general public should be significantly enhanced as to how science operates; in particular the role of the scientific debate and disagreement should be made more widely known.

- *Scientific literacy of citizens should be enhanced.* The public should not only be aware of scientific facts, concepts, and methods, but also it should be educated on the processes of how science operates – in particular, it should be made more aware that science advances through debate and contestation. This should be taught very early, and already be a component of science instruction in schools.
- *The public acceptance of scientific results should be promoted.* Greater transparency of science aided by science journalism, would enable the public to understand better how it is that scientists obtain their results. Greater awareness would, in turn, inspire greater trust.
- *Scientific literacy among public policy professionals should be a priority*. Civil servants should have basic training in understanding science and have direct access to scientists located in academia so as to obtain additional views as needed.
- *There is a need for appropriate funding to enhance the capacity of science journalism*. Science journalism is an important attribute of democracy and it is of outmost importance for the building of public trust in science. Thus, science journalism requires appropriate support in terms of funding and training. This is especially critical in countries where science journalism is not well developed.

Trust in science: Measures of combating opposition to and distrust of science, as well as mechanisms for maintaining and increasing trust in science are required.

- *The integrity of science journalism should be enhanced*. Integrity in science journalism is especially important given that there is a loss of public trust in journalism in general. To enhance integrity science journalists have a duty to ensure that the public receives only high-quality scientific information.
- *Scientists should remain impartial*. Scientists should recognize that personal motivations may influence their research and reporting of the findings and hence they need to be careful about making extravagant claims about their own research and/or belittling the research of others.
- *Institutions have a responsibility to ensure that the scientific information that they convey to the public is sound*. Institutions that convey scientific information to the public should be aware that the authority and credibility in which their institution is held by the public, will impact on the public's perception and the reliability that they place on what is being conveyed. They should ensure that communications with the public on the part of persons connected with the institution are accurate and sound.
- *Promote science-journalism cooperation for more effective public outreach*. Closer cooperation between scientists and journalists would enhance the quality of science communication. Such cooperation can be facilitated by an intermediary agency. There are a number of examples of such intermediary agencies.

Strong institutions for science advice: Strong institutions for science advice to policy ensuring interdisciplinarity, transparency and a capacity to draw on global science should be built.

- *The involvement of the science community in an advisory role should be broadened.* Some countries, for example, New Zealand and the US have strong science advisory systems, while many other countries are lagging behind. Engaging a wider scientific community covering a broad range of relevant disciplines will significantly improve the breadth and quality of advice. The existing bodies, such as the national academies of science, should be engaged much more systematically in reviewing existing policies and programmes and in preparing new initiatives, which could lay the ground for scientifically informed policy making (link).
- *The transparency of science advisory mechanisms should be significantly increased.* Science advisory bodies will be more effective if their operations are r transparent. This includes transparency to the general public and to relevant stakeholders, including the expert community. Expert judgement and evidential basis of given recommendations should be made transparent (link).).
- *Government structures should refrain from influencing scientific advice*. Only if the science advice is produced by independent scientists, it can be of high quality. Sir Robert May, then Chief Scientific Adviser to the Government and Head of the Office of Science and Technology (OST), published Guidelines on The Use of Scientific Advice in Policy Making in 1997, which later were several times updated (link). This document sets out key principles for government structures to apply in the use and presentation of scientific advice (link) and could serve as one example of good practice.
- *Ethical standards for research should be respected*. The WHO published Ethical standards for research during public health emergencies: Distilling existing guidance to support COVID-19 R&D. The document summarizes key universal ethical standards to ensure ethical research during the COVID-19 outbreak (link). In this regard, the International Network for Government Science Advice (INGSA) recommends the establishment of "national registries of researchers involved in emergency situations, and project details" and is developing a code of conduct for science advice in an emergency situation. (link).

- *Scientific advice to policy makers should be formulated and communicated in the way best suited for this audience category*. As a recent OECD report emphasized the advice of the scientific community to policy makers "can be a valuable, or even essential, input to sound policy-making but its impact depends on how it is formulated and communicated as well as how it is perceived by its target policy audience" (link).
- *Science advisory mechanisms should be further developed at the multilateral level*. In recent years, the United Nations has considerably enlarged the use of science advice in decision making process and introduced institutional adjustments in order to "balance scientific integrity and interaction between policy and science" (link). Some UN bodies have chief scientist positions, e.g. United Nations Environment Programme (UNEP) and World Meteorological Organization (WMO). The Scientific Advisory Board of the United Nations Secretary-General was created in 2013 (Secretariat is hosted by UNESCO). Then UN Secretary-General Ban Ki-moon underlined that "decision-making processes have to be informed by scientific evidence and knowledge, and that international and transdisciplinary scientific collaboration is a prerequisite to reach global sustainability" (link).

References

Kaplan D, Rovenskaya E, and Sizov S (2020). Second Background Paper. Input to the 2nd Consultation. Bouncing Forward Sustainably: Pathways to a post-COVID World. Strengthening Science Systems. IIASA-ISC

Rovenskaya E, Kaplan D, and Sizov S (2020). 1st Consultation Report. Bouncing Forward Sustainably: Pathways to a post-COVID World. Strengthening Science Systems. IIASA-ISC

Rovenskaya E, Kaplan D, and Sizov S (2020). Bouncing Forward Sustainably: Pathways to a post-COVID World. Strengthening Science Systems. Background Paper. IIASA-ISC

Strelkovskii N, Rovenskaya E, Sizov S, and Kaplan D (2020). Bouncing Forward Sustainably: Pathways to a post-COVID World. Strengthening Science Systems. Systems map. IIASA-ISC

List of Participants

Chair: Lidia Brito, Director, UNESCO Regional Bureau for Sciences in Latin America and the Caribbean

- **Kathie Bailey**, Director, Board on International Scientific Organizations (BISO), National Academy of Sciences, USA
- **Anne Bardsley**, Deputy Director – Koi Tū: The Centre for Informed Futures; Advisor – International Network for Government Science Advice (INGSA), The University of Auckland, New Zealand
- **Geoffrey Boulton**, Regius Professor of Geology Emeritus, University of Edinburgh, UK
- **Carlos Henrique de Brito Cruz**, Professor at the Gleb Wataghin Physics Institute at the State University of Campinas (UNICAMP), Brazil
- **Anne Cambon-Thomsen**, Co-chair of the Research Data Alliance (RDA) COVID-19 Working Group, France
- **Eran Feitelson**, Head of Advanced School for Environmental Studies, The Hebrew University of Jerusalem, Israel
- **Alexandra Freeman**, Executive Director, Winton Centre for Risk & Evidence Communication, University of Cambridge, UK
- **Barbara Kalumenos**, Director of Public Affairs, International Association for Scientific, Technical and Medical Publishers (STM), UK
- **Helga Nowotny**, Professor of Social Studies of Science Emeritus, ETH Zurich, Switzerland
- **Ingrid Petersson**, Director General, Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS), Sweden
- **Dorsamy (Gansen) Pillay**, Deputy Chief Executive Officer, Research and Innovation Support and Advancement (RISA), National Research Foundation (NRF), South Africa
- **Andrew Revkin**, Founding Director, Initiative on Communication & Sustainability, The Earth Institute, Columbia University, USA
- **Magdalena Skipper**, Editor in Chief, Nature, UK
- **Mandi Smallhorne**, Vice President of the World Federation of Science Journalists (WFSJ), South Africa
- **Pradeep Srivastava**, Executive Director, Technology Information, Forecasting and Assessment Council (TIFAC), India
- **Maria Uhle**, Program Director for International Activities, National Science Foundation (NSF), USA
- **Murray de Villiers**, Senior Manager, EMEA Academic Program, SAS, South Africa
- **Peter Weingart**, Professor Emeritus in Sociology of Science, University of Bielefeld, Germany
- **Xin Xu**, ESRC Postdoctoral Research Fellow at the Centre for Global Higher Education, Department of Education, UK

Annex 1

IIASA-ISC Strengthening Science Systems Team leadership

- **David Kaplan**, Senior Research Specialist, ISC
  Team Co-Leader
- **Elena Rovenskaya**, Program Director, Advanced Systems Analysis Program, and Acting Program Director, Evolution and Ecology Program, IIASA
  Team Co-Leader
- **Sergey Sizov**, Science Diplomacy Officer, IIASA
  Team Alternate Leader

IIASA-ISC Consultative Science Platform: Leadership Team, Members

- **Steffen Fritz**, Deputy Program Director, Ecosystems Services Management Program, IIASA
  IIASA-ISC Cross-cutting Champion on Data and Privacy
- **Luis Gomez Echeverri**, Emeritus Research Scholar, IIASA
  IIASA-ISC Consultative Science Platform Leadership Team, IIASA-ISC Cross-cutting Champion on Trust
- **Flavia Schlegel**, Special Envoy for Science in Global Policy, ISC
  IIASA-ISC Consultative Science Platform Leadership Team
- **Leena Srivastava**, Deputy Director General for Science, IIASA
  IIASA-ISC Consultative Science Platform Leadership Team
- **Caroline Zimm**, Research Scholar, Transitions to New Technologies Program, IIASA
  IIASA-ISC Cross-cutting Champion on Poverty and Inequality

Orientation and Extended Agenda

Objective of the 2nd Consultation

IIASA-ISC Consultative Science Platform "Bouncing Forward Sustainably: Pathways to a post-COVID World" aims to harness the transformative power of crisis to imagine a more sustainable world after the crisis caused by the new coronavirus outbreak. Strengthening Science Systems is one of four core themes of the project.

The process consists of three consultations. The 1st Consultation took place on 19 June 2020. It brought together prominent scientists from around the world to deliberate on the overarching question: *What are the key barriers that need to be overcome and what are the enabling factors that need to be reinforced in order to strengthen the capability of the science system to provide adequate input in crises triggered by extreme events like COVID-19?*

Ahead of the 1st Consultation a Background Paper (link) and a "Systems map" (link) were prepared by the IIASA-ISC team. The Background Paper analyzed critical issues within the science system that have been highlighted by the COVID-19 crisis. It identified three axes of improvement that are required so as to ensure that science can react more efficiently and effectively to global exogenous threats: *increased agility, enhanced reliability and a more effective science-policy-society interface*. The Systems map linked selected issues relevant for the three axes of improvement with each other and ultimately with the axes themselves. Apart from illustrating the elements of the science system and their inter-relationship, the Systems map allowed for the derivation of key barriers and enablers.

Building on the discussion of the 1st Consultation, a report and the Second Background Paper. Input to the 2nd Consultation with selected draft recommendations to address key challenges confronting the science system were prepared by the IIASA-ISC team for the 2nd Consultation. In order to facilitate systems thinking, the background paper for the 2nd Consultation contains a map of the interlinkages among the draft recommendations and their impact on the three axes of improvement.

These draft recommendations are presented in the Second Background Paper in three buckets. The first bucket, Access and partnership, focuses on issues of open science, peer review system, and partnership with the private sector, which are critical means to achieve *increased agility* and *enhanced reliability* of science in its service to society. *Increased agility* and *enhanced reliability* of science will also be facilitated through the recommendations from the second bucket, Agility and quality, that covers research priorities, funding, and scientific cooperation as key enablers of scientific progress. Finally, the third bucket, Public, policy and science, focuses on the public understanding of science, trust in science, and the science-to-policy advisory system, which ultimately help advancing towards *a more effective science-policy-society interface.*

The 2nd Consultation brings together funders, the private sector, science journalists, publishers and those concerned with public understanding of science.

Participants in the 2nd Consultation are encouraged to reflect on and critically review the proposed draft recommendations <u>before the meeting</u>.

Outcome

Based on the deliberations of the 2nd Consultation, a report will be produced summarizing the discussion of the draft recommendations. Participants will be invited to review and provide feedback on this report. The 3rd (and final) Consultation will be with policy makers who will further consider the recommendations, drawing on the discussion in the 2nd Consultation.

Annex 2

AGENDA

0-5’ Welcome

5-25’ Self-introduction of participants

25-35’ Orientation: Goals of the meeting and the process

35-1.35’ Break-away groups:

Group 1: Access and partnership
Chair: Geoffrey Boulton, Regius Professor of Geology Emeritus, University of Edinburgh

Recommendations to be discussed (see the Second Background Paper. Input to the 2nd Consultation for details):

- Efficient and effective peer review: The peer-review system should be seriously re-examined with regard to rigidity and slowness of paper processing.
- Open science: The move to open science – open access publishing; open methods, models, data; open to society – is a priority for science.
- Cooperation between public science and private sector: As many solutions rely on public-private research partnerships and on private sector technology platforms, mechanisms to enhance cooperation between public science and the private sector should be identified. Incentives for the public and private sector to share data and knowledge must be developed.

Group 2: Agility and quality
Chair: Helga Nowotny, Professor of Social Studies of Science Emeritus, ETH Zurich

Recommendations to be discussed (see the Second Background Paper. Input to the 2nd Consultation for details):

- Research on risk and systems resilience: Critical risks and the resilience of socio-economic-environmental systems should be a key focus of future research. Attention should be given to the decision-making contexts, policy implementation, and societal responses.
- Nimble re-direction of research efforts: Mechanisms must be put in place to allow researchers to move rapidly into new areas of public policy concern. This entails funding, performance evaluations for career development and leadership.
- Easy access to existing research: Mechanisms to facilitate utilizing already existing and emerging research results and insights to an exogenous crisis should be enhanced.
- Scientific cooperation at the regional and global scale: Traditional mechanisms for building and maintaining global research networks are breaking down. Attention should be paid to the development of new mechanisms to encourage scientific cooperation at the regional and global scale, and particularly, to developing networks centered in the South.

Group 3: Public, policy, and science

Chair: Prof. Eran Feitelson, Head of Advanced School for Environmental Studies, The Hebrew University of Jerusalem

Recommendations to be discussed (see the Second Background Paper. Input to the 2nd Consultation (Annex 2) for details):

- Public awareness of science: The awareness of the general public should be significantly enhanced as to how science operates; in particular the role of the scientific debate and disagreement should be made more widely known.
- Trust in science: Measures of combating opposition to and distrust of science, as well as mechanisms for maintaining and increasing trust in science are required.
- Strong institutions for science advice: Strong institutions for science advice to policy ensuring interdisciplinarity, transparency and a capacity to draw on global science should be built.

1.35-1.50’ Break

1.50-2.50’ Presentation of summary of deliberations at break-away groups and discussion (20’ for each break-away group)

2.50-3.00’ Final remarks, summary by the Chair and closing

Results of the Online Survey

The participants in the 2nd Consultation were requested to complete an online survey, which asked respondents to address the question: *Which elements should be the most important focus for policy makers to strengthen the capability of the science system and its capacity to provide effective input into policy in crises triggered by extreme events like COVID-19?* Sixteen pre-selected elements were provided. Figure 1 presents the survey results. Figure 2 presents the comparison of elements' assessments in two dimensions – the mean score and the fraction of high scores (9-10).

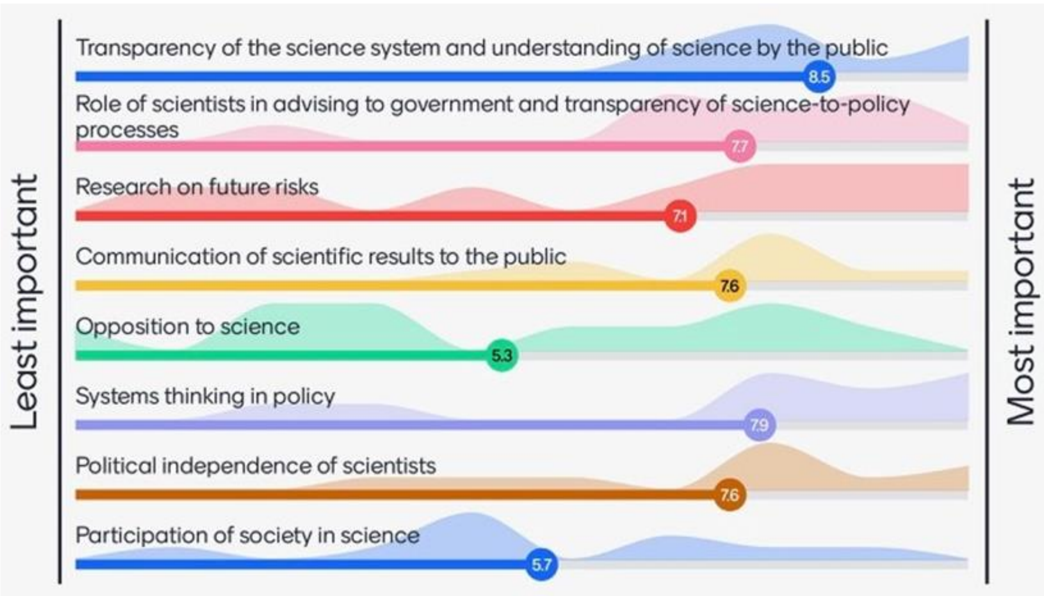

Figure 1: Survey results. Score distribution (shaded areas) and mean scores (numbers in circles) for each of the sixteen presented elements based on 14 (left panel) and 12 (right panel) responses by the participants. Score=1 means the lowest importance; score=10 means the highest importance.

Annex 3

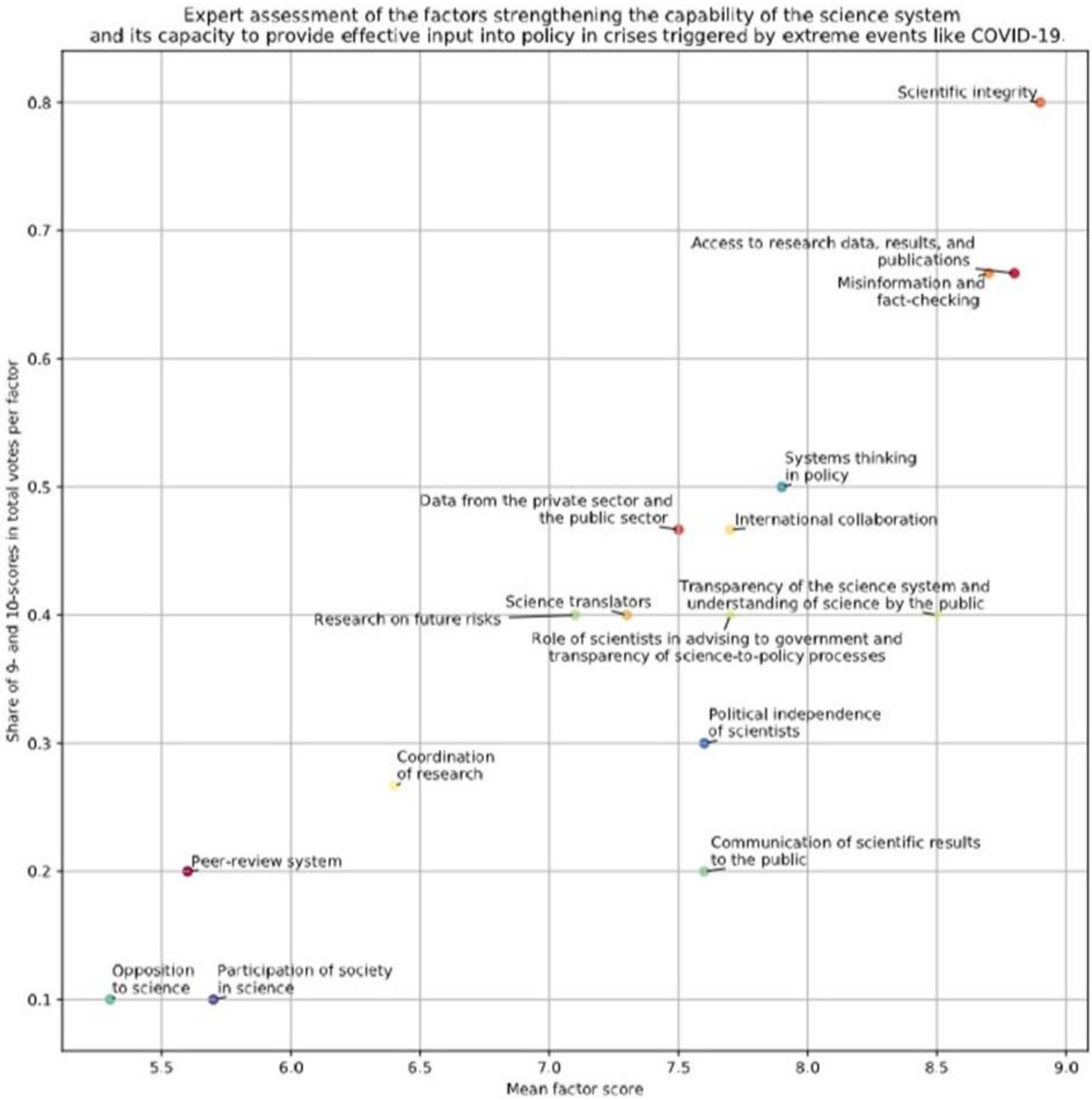

Figure 2: Comparison of elements' assessments. On the horizontal axis is the mean score and on the vertical axis is the fraction of high scores (9-10).